MICROANALYSIS OF PYROXENE GLASS IN ALH84001; M.S. Bell[1,2], K.L.Thomas-Keprta[2], and S. J. Wentworth[2]; and D.S. McKay[3], [1]University of Houston, Houston, TX 77058, [2]Lockheed Martin, 2400 Nasa Rd. 1, Houston, Tx, 77058, [3]NASA/Johnson Space Center, Houston, TX 77058.

Introduction: Martian meteorite ALH84001 is a brecciated cumulate orthopyroxenite containing minor amorphous feldspar material, and crystalline carbonate globules [1]. Evidence exists for possibly several shock events in ALH84001. In one event, the rock was cut by melt breccia or cataclastic veinlets, now bands of equigranular fine-grained pyroxene and other minerals. Another shock event produced microfault offsets of carbonate stratigraphy and other mineral contacts, radial fractures around chromite, and maskelynite (amorphous feldspar). Irregular, non-planar fractures are ubiquitous in pyroxene and some mosaicism is evident [2]. Amorphous feldspar material in ALH84001 has been examined and opinions differ as to its formation mechanism(s). Schwandt et al. [3,4] believe the feldspar material retains original igneous textures and was not shock melted. Shearer and Adcock [5] suggest that the feldspar glass may represent multiple shock episodes of injection-remobilization. In this work, we use transmission electron microscopy (TEM) and scanning electron microscopy (SEM) to describe nanometer-sized regions of pyroxene glass in ALH84001. These regions may represent incipient shock melting of the pyroxene.

Methods: Regions ~60 μm in diameter were cored from ALH84001 thin sections using a micro-coring device. The samples were embedded in epoxy, thin sectioned using an ultramicrotome, and analyzed using a JEOL 2000 FX transmission electron microscope (TEM) and JEOL 6340 FEG-SEM [techniques described in 6 and 7].

Results and Discussion: Glassy regions (~0.5 μm-2.0 μm) with pyroxene (opx) compositions and high Al content (ranging from 0.8-3.3 wt.%, Figs. 1 & 3) are located between the crystalline opx and rims of the carbonate (Fig. 2). Dark inclusions within opx (Fig. 2) are composed of carbonate rim material containing fine-grained (<200nm) magnetites indicative of shock formation in an event post-dating carbonate formation. Si-rich glasses (~0.5μm-1.0 μm; ~90% SiO_2) are also located near the opx-like glass regions. Orthopyroxene glass is also present between crystalline orthopyroxene and clinopyroxene (cpx) grains (Fig. 4) and in fractures surrounding the pyrite cores of brecciated chromites (Fig. 5).

The presence of ALH84001 pyroxene glass in trace amounts may be the result of incipient shock melting at pressures high enough to fracture and mosaic pyroxene, isotropize feldspar, and offset carbonates (~50GPa [8]).

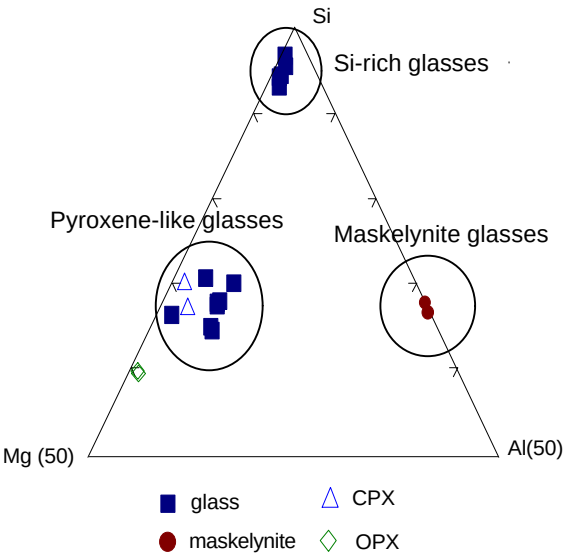


Fig. 1. Range of compositions for three types of glasses in ALH84001. The pyx compositions glasses are enriched in Al. The silica-rich glasses include minor amounts of Fe (0.5 wt%), Mg (<2.2 wt%), and Ca (<3.2 wt %).

Figure 2. Opx glass (yellow circle) surrounded by Opx and carbonate rim composed mainly of small (<200 nm) magnetite grains

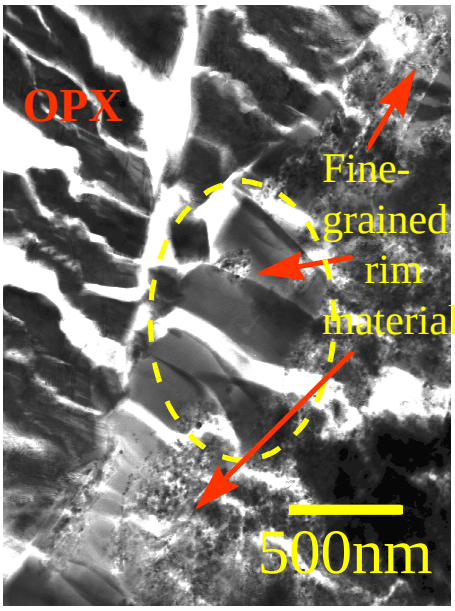


Figure 3. EDS spectrum of OPX glass. Note presence of Al. Full scale = 2000 counts. Cu is from the TEM grid.

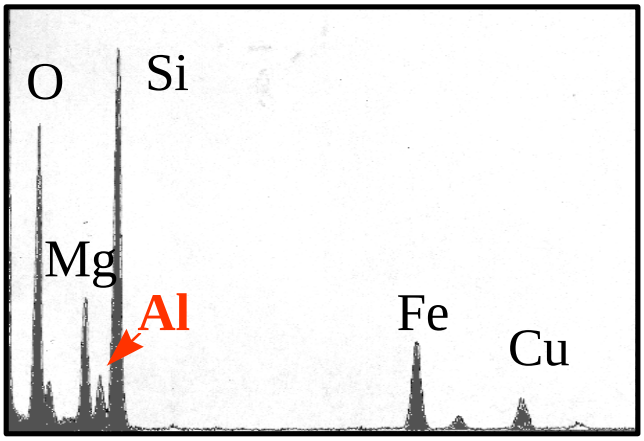


Figure 4. OPX glass (red circle) surrounded by CPX, fine-grained carbonate rim, and OPX.

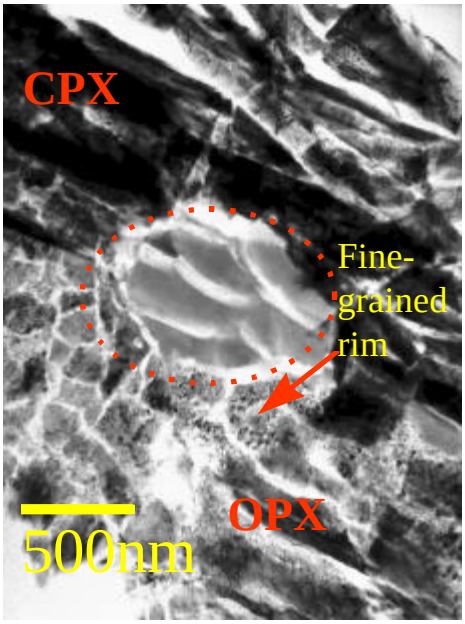
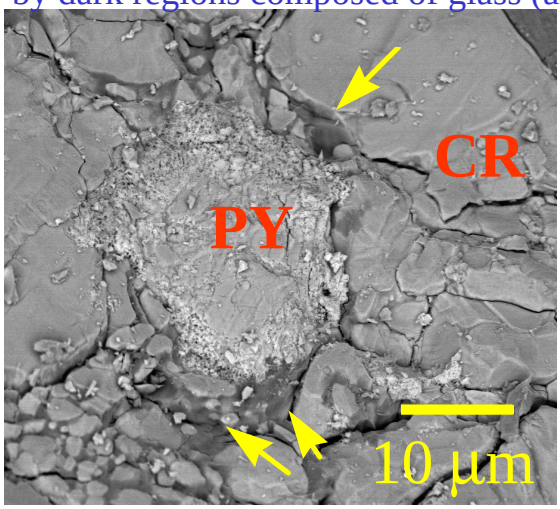


Figure 5. SEM backscatter image of pyrite (py) core of chromite (cr) surrounded by dark regions composed of glass (arrows).



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